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MOUNTAIN PINE BEETLE CONTROL PROJECT
COEUR D'ALENE NATIONAL FOREST
1939

James C. Evenden
Senior Entomologist

INTRODUCTION

Bark beetle control projects are comparable to other forest activities in that their success is governed by the character of the supervision. To assure sound and adequate supervision, each officer must assume responsibility for that phase of the operation to which he is assigned. In most instances it will be found that within an organization weaknesses result from improperly assigned men or inadequate instructions, both of which should be quickly remedied.

These instructions have been prepared with the idea of advising and assisting all project officers in the fulfillment of their entomological responsibility. Although presented in considerable detail, numerous situations will arise that have not been foreseen. In such instances the best judgment of the officer responsible must be used in arriving at a decision.

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SECTION I

THE MOUNTAIN PINE BEETLE AND ITS WORK

Within the white pine forests of Idaho and Montana, the mountain pine beetle has been responsible for the destruction of tremendous volumes of high-value, commercial timber. It has been conservatively estimated that from 1931 to 1937 inclusive the loss of white pine has averaged 91,783 MBF annually.

THE MOUNTAIN PINE BEETLE

The mountain pine beetle is a stout, cylindrical beetle varying in length from .2 to .35 of an inch. In its development it passes through three immature stages known as the egg, larva, and pupa. The larva when full grown is about the same size as the beetle, and is white and legless, with a small, brown or yellow head. The pupa, or the transitional stage between the larva and new adult, is also white. The pupa gradually assumes the form, shape, and color of a new adult.

EXTERNAL EVIDENCE OF MOUNTAIN PINE BEETLE ATTACK (Plate I, page 7)

Insect-attacked trees can be recognized from the boring dust lying around the base of the tree or caught in bark crevices, and by the small pitch exudations (pitch tubes) that form at the mouth of entrance holes. When the attacks are extremely heavy, the pitch tubes are quite small or sometimes absent entirely, so they must not be depended upon as an infallible guide to infested trees.

With light attacks the flow of pitch through the holes is usually so abundant that attacking beetles are often washed from their galleries and the attack fails. Large pitch tubes are in most cases, though not always, an indication of such pitched-out attack. Fresh woodpecker work is a true indication that there were and possibly are insects beneath the bark. However, it does not prove that the insect is the mountain pine beetle. Furthermore, there is seldom any woodpecker work on trees that were attacked late in the fall.

THE ATTACK PERIOD AND SEASONAL HISTORY OF THE MOUNTAIN PINE BEETLE

(Plate II, page 9)

There are three general attack periods of the mountain pine beetle in white pine; the first in June, the second and main attack from the middle of July to the middle of August, and the last from late August to the end of the season. Approximately one year is required for each of these broods to develop; consequently, the new adults from these three

attack periods emerge about a year later during the same attack period. The June brood passes the winter as new adults; the midseason brood overwinters principally as large larvae; while the late brood passes the winter as small larvae and eggs. In addition to their original attacks the parent beetles reemerge and make a second attack, that is usually in a new tree. As a result the reemerged parent adults often mingle with the new adults in the attack of individual trees. Although the general emergence and subsequent attack of the mountain pine beetle occurs during these three periods, there is some overlapping of the different broods. Furthermore, climatic variations will exert a pronounced influence on brood development, which may change the dates of these periods of attack.

HOW TREES ARE KILLED BY BARK BEETLES (Plate I, page 7)

The female beetle constructs a long, perpendicular egg gallery directly beneath the bark, which slightly grooves the surface of the wood. At the bottom of these galleries there is a short crook, or bend, an inch or two in length. The perpendicular portion of the gallery, which varies in length from 6 to 20 inches, nearly always follows the grain of the wood.

During the construction of this gallery, eggs are deposited in small niches along the sides. The eggs hatch in a few days into small white grubs, or larvae, which excavate short feeding tunnels at right angles to the egg gallery. The feeding tunnels vary in length and are exposed on the inner surface of the bark. When fully grown the larvae construct small pupal cells at the end of the larval mines in which they transform to pupae and new adults. The galleries constructed by the beetles girdle the tree, and cause its death.

THE NUMBER OF BEETLES THAT ATTACK A TREE

The number of beetles that must attack a tree in order to cause its death depends entirely upon its size and resistance to insect attack. Under normal conditions the number of attacks per square foot of bark surface will vary from 7 to 11, with an average of 9.

HOST TREES OF THE MOUNTAIN PINE BEETLE

The mountain pine beetle attacks white pine, lodgepole pine, sugar pine, ponderosa pine, whitebark pine, limber pine, and Engelmann spruce when occurring in association with pine.

RATE OF INCREASE IN BEETLE POPULATIONS

During normal years there is but one generation of the mountain pine beetle in white pine. By generation is meant the progeny that hatch at about one time, from eggs laid by one series of parents and which normally mature at about the same time. As each female lays from 60 to 100 eggs, and as there are equal numbers of males and females, the ratio of increase would be from 1 to 30 or 50. Fortunately there is a very high mortality of the developing brood as a result of various natural factors, so that only about eight percent of the maximum brood ever reach maturity and emerge. In addition to this destruction, there is what has been called a flight mortality caused by predacious insects, birds, and mammals, which feed on the beetles as they migrate from one tree to another. So it is very seldom that we ever have an increase in an infestation amounting to more than 250 or 300 percent.

OCCURRENCE OF MOUNTAIN PINE BEETLE INFESTATIONS

As the mountain pine beetle is indigenous to this region it is always present within our forests, occurring in what is called a normal or endemic infestation. From time to time these normal infestations increase into destructive epidemics. Such epidemic conditions follow the failure of factors that have previously contributed toward holding the injurious insect in check. It is often difficult to isolate the exact cause of such outbreaks, as there are a number of environmental factors that could be responsible. Some of the most important may be listed, as precipitation, temperature, predacious and parasitic insects, as well as abnormal quantities of attractive host material, such as blow-downs, slashings, etc.

THE DURATION OF EPIDEMICS

The answer to this question is indefinite. Insect epidemics last as long as there is a supply of host material remaining, or until nature restores a proper balance of the different factors involved. Some outbreaks are relatively short-lived, while others last for many years.

PREVENTION OF DESTRUCTIVE EPIDEMICS

As it is very doubtful if the mountain pine beetle can ever be eliminated from our forests, there will always be some losses resulting from the attacks of this insect. However, by keeping areas of valuable timber under proper surveillance artificial control measures can be instituted at the first indication of a serious increase in the infestation and timber losses reduced to a minimum.

DIRECT OR ARTIFICIAL CONTROL

There are a number of direct methods of artificial control, all of which are peculiar to different hosts and environmental conditions. Infested white pine trees are felled, the infested portion of the bole cut into logs, which are decked and burned. If the use of fire becomes dangerous and the insect broods are in the larval stage, peeling the bark from the infested logs will result in exposure of the immature stages of this insect which are at once destroyed by predacious insects, small rodents and insectivorous birds.

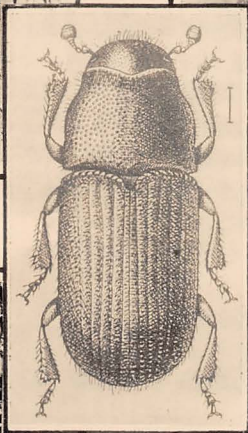
THE OBJECTIVE OF ARTIFICIAL CONTROL

When a tree has been successfully attacked, it cannot be saved, although its foliage may remain green for some months. Artificial control measures are directed toward the destruction of the insect broods beneath the bark of infested trees to prevent their emergence and attack of other trees.

DESCRIPTION OF PLATE I.

PAGE 7

- Upper left - Gallery pattern of Vancouver ips (Ips vancouveri).
From 3 to 4 egg galleries, radiating from central
nuptial chamber. Egg galleries open--not packed
with boring dust.
- Upper right - Gallery pattern of mountain pine beetle. Single
egg galleries with slight curve at bottom. Always
packed solid with boring dust, except for an inch
or two at upper end.
- Center - Mountain pine beetle.
- Lower left - Pitch tubes.
- Lower right - Boring dust around base of tree.



DESCRIPTION OF SEASONAL HISTORY CHART
PLATE II PAGE 9

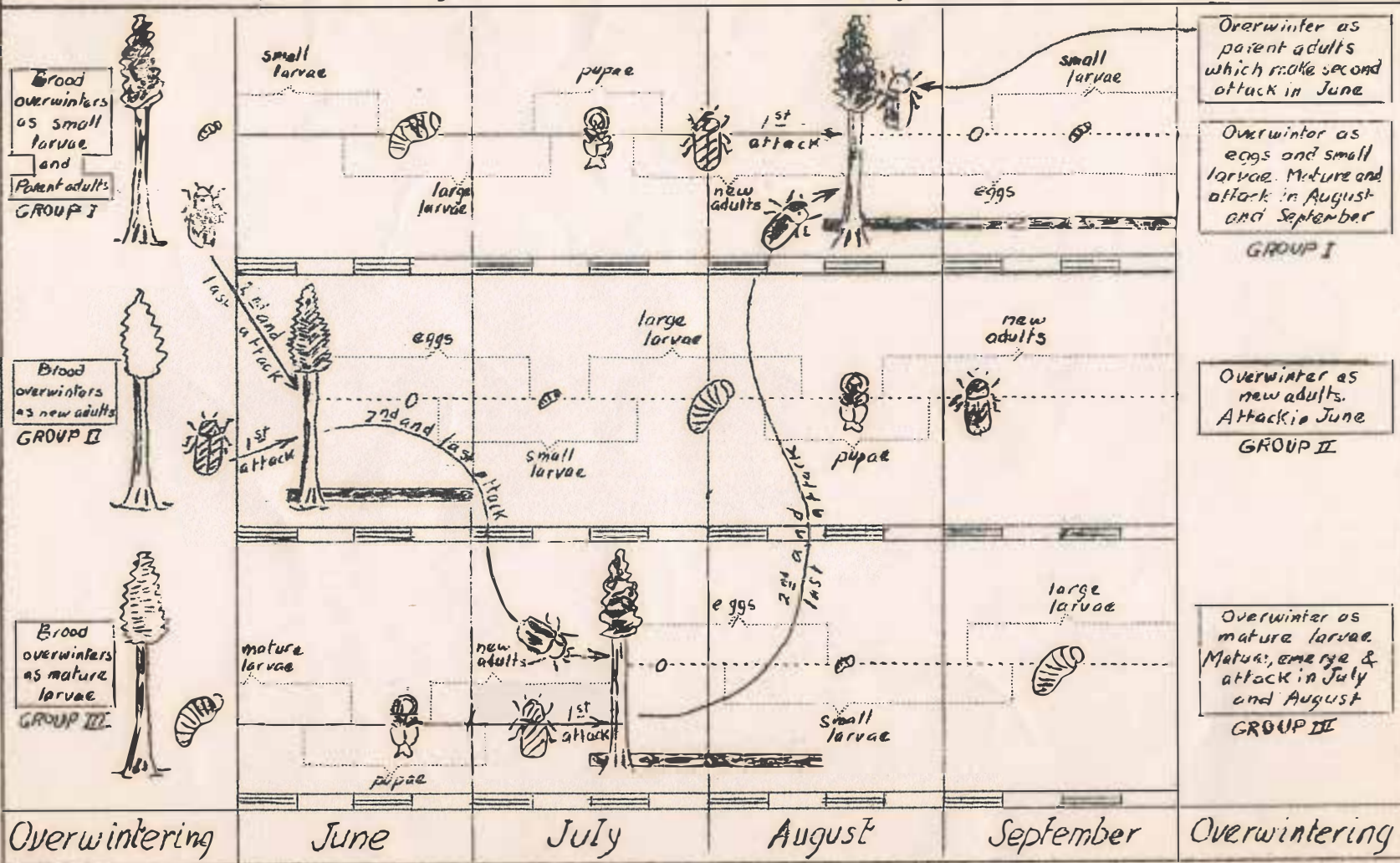
Legend

- Cross hatched beetles - New adults, which are beetles that have not yet made their first attack.
- Black beetles - Parent adults, which are beetles that have made their initial attack.
- Black lines - Extending from tree bases, represent periods over which attacks are made.

PLATE II

SEASONAL HISTORY OF DENDROCTONUS MONTICOLAE HOPKINS

in Western white pine. Showing attack periods - beetles causing attacks - and brood development



SECTION II

SPOTTING

Spotting consists of locating, marking, and mapping all infested trees for subsequent relocation and treatment. It is the first and most important step in all bark beetle control projects, and the need for efficient performance can not be overemphasized. The location of infested or insect-attacked trees is but a mechanical operation, which, if one is alert, can be made 100 percent effective, although the task of determining if a tree showing external signs of bark beetle attack should be marked for treatment is often a difficult one. It is impossible to foresee the many problems that will be encountered in order to offer tentative solutions. The fundamental principals of spotting have been set forth in the following paragraphs as an aid to the chief spotters, who are given the responsibility of this important phase of bark beetle control.

ORGANIZATION OF SPOTTING CREW

Six-man spotting crews are used to locate white pine trees infested with broods of the mountain pine beetle. These crews are composed of a chief spotter, a compassman and four spotters.

OPERATION OF SPOTTING CREW

Spotting crews operate by traversing a section, or block of timber, through which parallel lines are projected on definite compass bearings. Trails, roads, or ridges can be used as base lines in unsurveyed territory. Even in surveyed territory it is more advantageous to use a natural or artificial base line or to establish one in a desired location. Base lines should parallel drainages so that the spotting crews will work up and down hill, rather than along contours. When artificial base lines are established, stations should be established at four chain intervals. The first station will of course be but two chains from the start of the line. Where strips cross main trails or roads a tag showing the number of the strip should be fastened to a convenient tree or bush. These marked strips will be of material assistance to crew foremen in the relocation of marked trees. Under all circumstances spotting should start from some known point, such as a section corner, bridge, gate, or trail crossing, to facilitate map construction.

The chief spotter is charged with the conduct of his crew and must exercise constant supervision over the compassman and spotters in order that their work be properly performed. It will be necessary for the chief spotter to examine nearly all infested trees to see if they should be marked for treatment. In addition to the supervision of his crew the chief spotter is charged with the submission of required reports, maps, etc.

The compassman will be responsible for the compass work, pacing of distance traveled, and the construction of a map showing the number and location of all trees marked for treatment. These maps must be kept up to date, with each day's data being added to all copies.

Each spotter is responsible for the examination of all white pine trees on a strip one chain wide on one side of and parallel to the course of the compassman. A one chain strip permits a close examination of all trees with a minimum of side travel.

Spotting crews are formed with the compassman in the center and two spotters on each side. The compassman serves as a guide to the inside spotters whereas the outside men are guided by the inside spotters and also by the compassman if he can be seen. The speed of the compassman must be adjusted to the efficient operation of the crew. Advancing formations should always be wedge shaped, as proper positions are more easily maintained and strips more thoroughly covered when the spotters are a trifle in the rear of their guide. Under no circumstances shall spotters advance ahead of the compassman. The spotter who was on the outside course should be on the inside during the return trip on the adjoining strip, as he will be more familiar with the boundaries of his strip and will leave no ground uncovered. The chief spotter stays from 2 to $2\frac{1}{2}$ chains behind his crew, and by following a zigzag course the entire strip can be effectively covered and the marking of infested trees properly checked. The alignment of spotting crews is important, and must be insisted upon by the chief spotter.

When an infested tree is located, the spotter stops the progress of the crew, obtains a number from the compassman, and places it upon the tag. When groups of infested trees are encountered the entire crew assists in marking all trees, even though the group may extend into the next strip. When this task is completed the crew moves in formation through the groups of marked trees, marking and recording any that have been missed.

Infested trees are marked with white or yellow cloth tags fastened to the tree with a tack in each upper corner. The data placed upon this tag will include the tree number, crew symbol, the spotter's initials, and possibly other desired information. Each spotter will carry a supply of tags on which he will have previously placed the crew symbol near the top and his initials in the lower right-hand corner. In addition to the tag the opposite side of the tree is blazed and marked with the tree number, which facilitates relocation in case the tag is destroyed or if the tree is approached from the opposite side. Lumberman's crayon is used for marking tags and trees.

DETERMINATION OF TREES TO BE MARKED FOR TREATMENT

Although from external evidence of attack it is relatively easy to spot most infested trees, it is necessary to make a thorough visual examination of the basal portion of every white pine tree if all trees harboring broods of the mountain pine beetle are to be located. Furthermore, when infested trees are located, careful examinations are essential in determining if they should be marked for treatment.

Trees are sometimes attacked on one side only and these are often missed by spotters unless care is exercised.

When the unattacked side of these trees is infested later in the season or the following year, the succession of attacks will confuse spotters, and make the determination as to the need for treatment rather difficult. Such trees should be marked if they contain broods of the mountain pine beetle in sufficient numbers to warrant such action.

Insect-killed trees sometimes have a green, unattacked spot of a few square feet of bark surface left at the base. As this green area is often attacked the following season, during spring control operations one will find live brood at the base of red-top trees attacked two years previously.

A marked variation in the foliage discoloration of white pine trees infested with the mountain pine beetle prevents its being used as an index or guide to the status of brood conditions. Some trees attacked early in the season will show a marked foliage discoloration by fall, while others will remain green throughout the winter. From some of the discolored trees there will be a partial emergence of newly formed adults in late October and September, while in others there will be normal overwintering broods of large larvae. A proper basal examination is the only method of determining the brood status of all trees. The marking of these trees for treatment is the full responsibility of the chief spotter. Trees will not be marked when there are only a few insects remaining as the emergence from the upper portion of the bole is in most cases much heavier than at the base. The presence of parent adults alone is not sufficient basis for treatment unless the attack is new. There may be instances where spotters will be called upon to separate attacks of secondary bark beetles from those of the mountain pine beetle. This is not a difficult task when one is familiar with the gallery pattern of the mountain pine beetle. (Plate I, page 7)

Although these instructions are intended to assist spotters in their assigned tasks, the marking of trees which represent border line cases is very largely a matter of judgment based upon training and experience. To assure efficient spotting, the base of every white pine tree must be examined. When external evidence shows the tree to be, or to have been infested with beetles, it is necessary to remove a piece of bark to determine the status of the beetle brood. In many instances it will be necessary to carefully examine all four sides of the tree

before a proper decision can be reached. Care must be taken to prevent the unnecessary chopping into green uninfested trees. Bark beetle broods are found in all stages of development, i.e., eggs, larvae, pupae, and new adults. The old parent adults will be found in the ends of egg galleries. In most instances they will be dead. Parent adult emergence holes start from the upper end of egg galleries. Prior to emergence the new adults range in color from light to dark brown or black.

SPOTTER-CHECKERS

The work of spotting crews will be checked at regular intervals. These checkers will run sample strips through the spotted territory, obtaining data relative to the number of tagged and untagged infested trees. From these data a percentage figure depicting the efficiency of the different spotting crews will be obtained. The location and proper marking of all infested trees will be considered as satisfactory spotting.

Spotter-checkers will report directly to the camp manager. In no instance will the data they obtain be made available to chief spotters, or to other members of a crew organization.

SPOTTING EQUIPMENT AND RECORDS

Spotting Equipment (Six-man Crew)

- 1 Standard staff compass -- staff
- 2 Talley registers
- 1 Tatum holder, 5 x 8 for map sheets
- 5 Light belt axes
- Map sheets
- Pencils -- 2 H. Red.
- Tags
- Tacks
- Lumber crayon
- Carbon paper

Marking Tags

Tags used in marking trees should be approximately 4 x 6 inches in size and of a color easily discernible in the forest. Sign painter's cloth has been used successfully for this purpose. Tags are removed by the treating crew and given to the camp manager as a check upon the trees treated.

Mans

Spotters' maps are prepared on Forest Service map sheets (Form 878-a). As the purpose of these maps is to serve in the relocation of marked trees, it is necessary that they be neatly and accurately prepared. Care and consideration by the mapper will save hours of unproductive labor by treating crews. In covering surveyed territory only one selection or part thereof should be shown on each map sheet. The tree number is placed by the side of the spot that designates the location of the marked tree, (.93, .104). When a group of trees is located a small circle indicating their location is placed on the map with the included numbers by the side, ○ (94 - 103).

Only essential data should be shown, and minor details of topography, which in most instances are of no service, should be omitted. Trails, streams, ridges, peaks, fences, cabins, telephone lines, etc., are essential features which will be of assistance to treating crew foremen.

Spotter's Daily Record, I. C. R1-1

This form is used by the compassman to keep a record of tree numbers used and is turned in to the camp manager at the end of each day's work. Consecutive numbers assigned to each crew will be placed on the form before leaving camp. As numbers are given to spotters they are checked in the column marked "S" as spotted. This form is used by the camp manager or treating crew foreman, who checks under "T" as treated, all tree numbers from the tags turned in by treating crew leaders, which shows the numbers of any missed trees. The chief spotter begins his daily record sheet with the number following the last one used the previous day.

Spotter's Weekly Report, I. C. R1-2

This form is prepared by the chief spotter for the purpose of reporting the accomplishments of the week as well as information concerning the remainder of the area to be spotted. This form should be filled out as thoroughly as possible since the information it contains will aid in the final plans for the project.

SPOTTER'S WEEKLY REPORT

[illegible]

Crew Symbol	Number of Men in Crew
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
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80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

Total Man-days

Chief Spotter

Record of Trees Marked For Treatment

Date	Number of Trees	Acres	Area Worked	Remarks
Total				

Amount and location of remaining territory to be covered under present assignment

Number of days required to complete present assignment

Suggestions for assignment of treating crews

Remarks

SECTION III

TREATING

Although it can be properly said that spotting is the first and most important task in connection with bark beetle control projects, the proper treatment of infested trees is of equal importance. Although the treatment of infested trees is not a technical task, constant supervision is necessary to insure each phase of the operation being properly performed.

ORGANIZATION OF TREATING CREWS

Treating crews are composed of five or six men, including a crew leader, two sawyers, and two or three swampers. A treating crew foreman will have direct supervision over the treating crews of each camp, and will be responsible for the character of the work performed. Each treating crew leader will be in direct charge of a treating crew and responsible for the work performed by his men.

OPERATION OF TREATING CREWS

When infested trees are to be burned, two men are detailed as sawyers who fell the trees and cut the infested portion of the bole into lengths capable of being decked by hand. The other members of the crew deck and burn the infested logs.

When the treatment consists of peeling only, the trees are felled and cut into such lengths that will facilitate turning. If the logs are to be salvaged they must be cut in 16.6-foot lengths.

DETAILS OF TREATING, DECKING AND BURNING

1. The entire infested length of the bole must be treated. It is not necessary to treat the upper portion of the bole when infested with secondary bark beetles. Of these secondary beetles, Ips vancouveri will be the only one that will cause confusion. The work of this insect can be easily separated from the mountain pine beetle as shown in plate I, page 7.

2. All logs that are to be placed in one deck must be of a uniform length, so as to prevent the occurrence of unburned log ends. Log lengths are governed by the diameter of the trees in question, which is an important factor in hand decking.

3. All logs on the bottom of the deck must be placed flat on the ground. They must not be placed over holes or depressions in the ground or piled crossway on skids. Dry brush can be placed on the ground on which the logs can be decked. However, all poles or chunks must be laid parallel to the logs. Logs must be decked closely together and with the ends fairly even so that there will be no large holes or spaces either in the deck or under it. When such spaces occur good burns will not be secured.

4. Decks must be at least 3 logs high. No decks of less than 5 logs should be made, which may require single trees to be cut into short lengths. Small decks should be covered with brush and other inflammable material before burning.

5. Decks must be placed in openings at least 25 feet from the nearest white pine tree.

6. After a deck has been built some dry limbs and other material should be placed along the outside logs. This will assure the scorching of outside bark surfaces.

7. Fires will be started at the lower end of all decks.

8. Stumps will be peeled. It is only necessary to peel as far down as the infestation extends. Green bark need not be removed.

9. Care must be exercised so as to prevent fires from creeping into decayed logs or stumps where hold-over fires may exist for weeks.

10. If any fire hazard exists, all decks must be trenched, and no fires started until late in the afternoon or at some time when conditions are more favorable for burning.

11. After a deck of infested logs has been fired, it must be tended regularly until all infested bark surface has been burned. One man is usually detailed to watch several decks, and he rolls unburned portions of logs together before the fire burns out. It is best to fire large decks late in the afternoon, as they will burn all night and there will be enough fire left the following morning with which to burn the unscorched portions of the logs. As smaller decks burn much faster and need more attention, it is best to fire them in the morning in order that they can be tended during the afternoon.

12. During seasons of relatively high fire hazard, night burning must be resorted to. Decks are built and trenched by treating crew during the day, but are burned during the night by two or three men. Fires are started about 7 o'clock in the evening, and are watched all night. By rolling the burning logs together, the fire is fairly safe by morning, and with care there will be no danger of the fire spreading. However, such decks must be watched during the following day or until the fire is out.

13. When decks are not burned as constructed, they must be tagged in the same manner as an infested tree. The treating foreman must construct a map showing the location and the number of each unburned deck. The tag is placed on a nearby tree, and is collected by the treating foreman when his inspection shows that a complete burn of all infested material has been accomplished.

ADMINISTRATIVE DUTIES OF TREATING FOREMEN

In addition to the responsibility of seeing that all treating is conducted in accordance with preceding instructions, treating foremen are responsible for the following phases of the operation.

1. To direct the work of treating crews so that they will not be so close together as to interfere with or endanger each other, but sufficiently grouped as to permit proper supervision. Each day's work must be planned so as to reduce the travel time of treating crews to a minimum. The crew foreman will use the spotters' maps to relocate trees marked for treatment and will direct the crew leaders to them.

2. To see that each crew leader submits at the end of each day's work the "Crew Foreman's Daily Report" with the tags from the treated trees.

3. To check the tree number on the tags submitted by each crew leader against the Spotter's Daily Report, to see that no trees have been missed.

TREATING EQUIPMENT AND RECORDS

Treating Equipment (Five-man Crew)

- 1 5½ saw and handle
- 1 Single jack
- 2 Falling wedges
- 3 D.B. axes, 3½#
- 3 Cant hooks (4-foot)
- 1 Shovel
- 3 Peeling spuds (if logs are to be peeled)

Crew Foreman's Daily Report, I. C. Form R1-3 (1939)

This report is submitted by each crew leader showing the number of trees treated, and their d.b.h. The tags that were removed from these trees should accompany this form as it is turned in to the treating foreman.

Work Supervisor's Weekly Report, I.C. Form R1-4 (1939)

This report is submitted by the camp manager at the close of each week's work, and gives a recapitulation of the output, in trees per effective man-days.

WCRK SUPERVISOR'S WEEKLY REPORT

Camp _____

Week of _____ to _____

Production - Spotting

Chief Spotter	Days worked	Total man-days	Total acres covered	Number trees spotted	
Totals					

Production - Treating

Foreman	Days worked	Total man-days	Trees treated	Trees Treated per man-day	
Totals					
*Nonproductive man-days					
Total man-days					

*Include all time other than spotting and treating.

Camp Manager